CORRESPONDENCE.

SHIP BUILDING.

FERRYSBURG, Mich., Dec. 7, 1882.

EDITOR ENGINEERING NEWS:

I am glad to see that the subject of vessel building has found its way into your journal, but I am sorry to find Mr. Haug, or the printer considerably off, in almost the first paper. See "Engineering Societies," page 411, of ENGINEERING NEWS for Dec. 2, 1882.

In the fourth paragraph we read of "Extreme Proportions," whatever that may mean. I suppose it is of a class with "magnificent proportions," "huge proportions," "immense proportions," "stupendous proportions," "enormous proportions," etc. All of which terms we see at times in the papers, but as Webster nor the mathematicians give us any information concerning them I am at a loss to understand what is meant by "extreme proportions."

In the same paragraph, he gives us the length of the vessel in terms of "depth." The length of the vessel is generally given in terms of the breadth, called "beams." If he had said the vessel was over 11 beams in length, he would have been nearer the mark. In the same paragraph, too, he tells us about strengthening the vessel in the top and bottom members by "doubling strokes." If he had reference to the fore and aft courses of plank or plates, he should have used "strakes."

But further, along, we find "stemports" in connection with "rudders," "stems," etc. What does "stemports" mean?

NEGATIVE SLIP.—I see, too, by other journals, that the ghost of "Negative Slip," of propeller wheels, is still tolerated, and even professors of engineering presume to explain it and tell us how such a thing can be. This absurd idea comes from the fact that engineers have not yet learned how, or rather where to measure the pitch of a wheel blade. This statement may be deemed a broad assertion, but it is too true, as I will try to show satisfactorily. And in my efforts, where so many others have failed, to lay this ghost, perhaps I may be excused for being a little elementary.

We may premise that this property of "Negative Slip," so called, is peculiar to that class of wheels, having a "gaining pitch," *i. e.*, one in which the angle of pitch increases from the leading to the trailing or following edge of the blade.

Conceive the blades of the wheel to be intersected by a cylinder whose axis is concentric with the center of the shaft. And let the curve *A. C.* (Fig. 1) be the developed intersection of the same, with the concave or working face of the blade. Then, drawing *A B* at right angles with the shaft, and *B C* parallel with the same, we have in *B C* the mean pitch (so called) corresponding to the width of the blade. *B C* is also the length of wheel, and *A C* is the width of blade, the point *C* being in the leading edge, and the point *A* in the trailing edge of the same.

From *C* set down *C D* equal to the slip, and join *A D*. Then in the line *A D* we have what may be called the *the line of motion*, for any point in the curve *A C* moves in a helix, which, when developed on a plane, is strictly parallel with this line.

When this curve is properly designed or adapted to the pitch of the blade, the tangent of the curve at *C* will be parallel to the line *A D*, in which case the initial pressure of the blade at this point will be zero. The intensity of the pressure will increase from *C* to *A*, where it will be at its maximum, for at this latter point the inclination of the blade to its "line of motion" is also at its maximum. But the motion for all points in this curve being the same, the work done at any point will be as the intensity. That is to say, the work done by any elementary helecoidal area, whose section is represented by the curve *A C*, may be represented by the area of a triangle, whose base is at *A* and vertex at *C*.

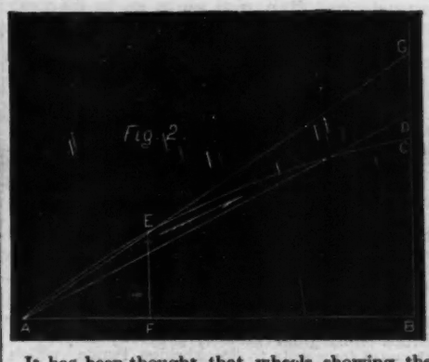
But the pitch is to be measured at the center of gravity of the work done. Moreover, the center of gravity of the area of a triangle is at one-third of the height of the triangle from the base. Whence, *we are to measure the pitch at one-third of the distance (measuring along the curve) from A to C.* That is to say, take the arc *A E* one-third of *A C*, and through *E* draw the secant *A C*, intersecting *B C* produced in *C*. Then is *B C* the actual working pitch, corresponding to the width of the blade; it is this pitch that determines the motion of the vessel; and *B C*, which is generally called the actual mean pitch, *is only a part of the same.* *B C*, too, has been called the full slip, but it is now seen to be only part of the same.

If it should be desired to find the pitch of the whole wheel from that corresponding to one of the blades, we must bear in mind that the line *A B* is the developed arc of the circumference corresponding to the width *A C* of the blade. Then dividing *A B* by 3.1416, the ratio of circumference to diameter, we shall have the corresponding diameter; and dividing *B C* or *B G* by this diameter, we have the *nominal* pitch, or the *actual* pitch, as the case may be. Or by formula,

$\overline{B C} \div \overline{A B} \div 3.14 =$ the *nominal*, or so called main pitch, in terms of the diameter, and

$\overline{B G} \div \overline{A B} \div 3.14 =$ the *actual* or *working* pitch in terms of the diameter. "Negative Slip" will never make its appearance with this pitch.

In the case of what is called "Negative Slip," "the line of motion," *A D*, runs *forward*, off and across the curve of the blade, as in (Fig. 2). This comes from giving *too much curvature* to the blade. The difference between the pitch of the forward edge of the blade and that of the after edge is made too great, causing the tangent of the curve at *C* to run *behind* the line of motion, *A D*. By this means, the forward part of the blade does *negative* work, and the useful work is thrown upon the after portion of the blade, which thus propels the vessel *in spite* of the forward part.



It has been thought that wheels showing the property of "Negative Slip," so-called, were very desirable, but it is an erroneous conclusion. Indeed, they are to be avoided as we would shun any other wasteful agent. For, besides the direct loss of power in the negative work of the forward portion of the blade, we find undue loss in the after portion, from the increased obliquity at the point where useful work is done. Moreover, such wheels are unnecessarily wide, thereby absorbing a vast amount of power in useless friction and disturbance of the water.

Many other serious mistakes, entertained by eminent engineers, and promulgated by the bookmakers could be enumerated, but this paper is already too long.

H. C. PEARSONS,
U. S. Inspector of Steam Vessels.

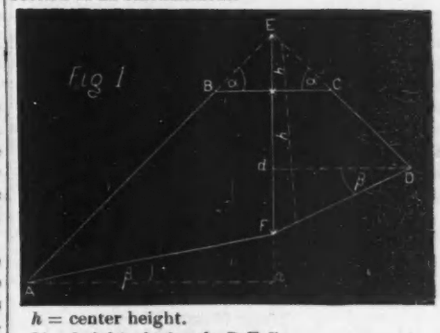
EARTHWORK CALCULATIONS.

SOUTH PENNA. R. R.,
SOMERSET, Pa., Dec. 12, 1882.

EDITOR ENGINEERING NEWS:

In several numbers of your paper I found more or less practical communications about rapid calculations of earthwork. In some methods the cross-sections must be plotted, in others diagrams are proposed. As in many cases the estimates are made by the party in the field, the carrying of the least papers possible is desirable.

In "Winkler's Vorträge über Eisenbahnbau," I found some very practical formulæ entirely based upon calculation, and I suppose not generally known in America. Fig. 1 represents the cross-section of an embankment.



h = center height.
h' = height of triangle $B\,E\,C$.
α = slope angle of embankment.
β and β' slope angles of the ground right and left from center stake.

$A\,B\,C\,D = \triangle\, A\,E\,F + \triangle\, E\,F\,D - \triangle\, B\,E\,C.$

$\triangle\, A\,E\,F = \frac{1}{2}\,(h + h') \times A\,a.$

$\triangle\, E\,F\,D = \frac{1}{2}\,(h + h') \times D\,d.$

$Aa = (h + h' + Fa)\cot.\,\alpha \quad Dd = (h + h' - Fd)\cot.\,\alpha,$
$Fa = Aa\,\tan.\,\beta \qquad Fd = Dd\,\tan.\,\beta'.$

$$\text{Thus. } Aa = \frac{h + h'}{\tan.\,\alpha - \tan.\,\beta'} \qquad Dd = \frac{h + h'}{\tan.\,\alpha + \tan.\,\beta'}$$

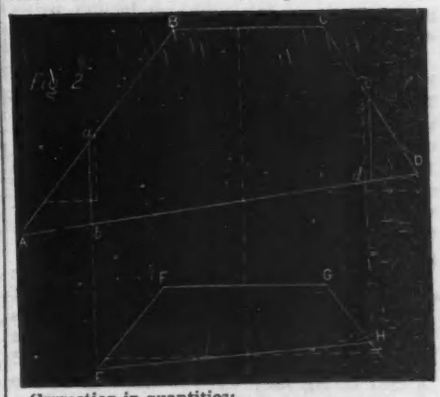
$$\text{and } \triangle\, A\,B\,F = \frac{(h + h')^2}{2\,(\tan.\,\alpha - \tan.\,\beta')}$$

$$\triangle\, E\,F\,D = \frac{(h + h')^2}{2\,(\tan.\,\alpha + \tan.\,\beta')}$$

In these formulæ h', α and $\triangle\, B\,E\,C$ are constant for each formation. We remark that for an embankment α + slope gives α + tangent and α — slope α — tangent.

Excavations considered as reversed embankments, we must also reverse the signs of the transverse slope of the ground.

In embankment α — transverse slope of the ground augments the area, thus divider in the formula must diminish, in consequence the tangent β negative; in excavation α — transverse slope of the ground diminishes the area, thus divider must increase and tangent positive.



Correction in quantities:

In your number of Dec. 9, Mr. Shunk gives a very valuable diagram for those who are in possession of other diagrams and tables, reducing transverse ground slopes to level cuttings. But for those who follow the method of calculating, the following method gives a very close result. The prismoidal content between the sections *A B C D* and *E F G H*, distance *l*, is equal to:

$$\left(\frac{ABCD + EFGH}{2} - \frac{Aab + cdD}{6}\right) l$$

Generally for calculating quantities from the areas of the cross-sections, only the first part of the formula is taken. We get then too large quantities which must be diminished by $\frac{A\,a\,b+c\,d\,D}{6}\times l$.

In plotting the cross-sections along the same axis, those triangles are easily calculated, but also without plotting we come to a very close result in neglecting the transverse slopes of the ground and considering the sections a trapezoid with center-height as height.

For two sections with center heights h and h' and slope formation n we get for

$\frac{A\,a\,b+c\,d\,D}{6}\,l$ the expression $\frac{(h-h')^2}{6}\,nl$.

As a comparison we have calculated an embankment for 100 ft. length, 24 ft. roadway, 1½ slope; transverse ground slope 10°, center heights at the end 10 and 20 ft., and get: By using Trautwine's diagram and tables, 4,317 c. yds.; by using Trautwine and Shunk's diagram of average heights, 4,512 c. yds.; by using our formula, 4,532 c. yds.; by calculating the quantities from the end-section without correction, 4,922 c. yds.

Yours respectfully,

E. THIANGE, C. E.

DIFFICULT EARTHWORK MEASUREMENTS.

Ulster County Division,
New York, West Shore & Buffalo Railway,
MARLBOROUGH, N. Y., Dec. 8.

EDITOR ENGINEERING NEWS:

In my article of Nov. 11 explaining manner of taking measurements on rock work under difficult conditions, I see I am taken severely to task in your issue of Dec. 2, by Mr. J. C. Isaaci, assistant engineer on the Yellowstone Division, of the Northern Pacific Railroad, for allowing a contractor to work a cut in such a manner as to break back of the original section and he shows in his article how *he does* and would work a rock cut, viz.: in horizontal courses, and by using a templet commence at the slope stake and work therefrom to grade. This manner of working a cut will answer very well where conditions are the same as on Isaaci's cut on the Yellowstone, viz.: soft sandstone intermixed with clay; where he can define the "geological strata for classification" as his work proceeds. But there is a vast difference between chalk and cheese, and between soft sandstone and a mixture of clay, worked with a pick, a little powder, and a shovel, and limestone and slate rock, classified by the Creator as *very solid* rock, and worked entirely by drilling and high explosives, as along the Hudson River.

An old engineer just returned from the Yellowstone Division, who has been on that work for nearly two years, in answer to an inquiry, writes me as follows:

"In some cases the bluffs were worked with a horizontal base from the top, but very seldom. The slope originally was ¼ and in some cases ⅓ to 1, and was set back because it would not stand at that slope to ½—⅔—¾, and in some cases 1 to 1. The rock is a very soft sandstone and in one stratum of lignite and indurated clay, and the slopes can be very easily worked with picks, and that it is possible to get a very uniform slope. Considerable power is used."

Mr. Isaaci says a contractor should receive the most severe censure for creating gouges back of original section. Does censuring his contractors on the Yellowstone make the material stand at ¼ to 1. He must have sworn loud at ¾ and damned outrageously when it had to go back to 1 to 1. Would the latter not be a big gouge back of the original slope stake? If the wisdom and long-sightedness of some gouge engineers had, perhaps, been coupled with that of the Great Supreme Architect thousands of years ago, we should have had all of our rock laid in strata standing at ¼ to 1, to accommodate railway building, and not stand at all angles, as He has seen fit to place it, necessitating great gouges and set-back of slope.

Come East, Mr. Isaaci, and study how the rocks lie in their native beds on the Hudson River, and have templets cut at all angles for them.

R. SMITH HENRY,
Asst. Engr. Ulster Co. Division.

LONGEST TANGENT.

EDITOR ENGINEERING NEWS:

In reply to query as to the longest tangent, I would say that there is one on the Camden & Atlantic R. R., in New Jersey., about 32 miles, and one on the Northern Pacific, from Fargo, west through Dakota, about 60 miles in length.

L. M. H.,
University of Pennsylvania.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.

(*Continued from page* 419.)

CCCCXXVI.—SAGINAW CITY.

Saginaw City, Michigan, in lat. 43° 25′ 1″ W., long. 83° 57′ 8″ W., is on level ground on the Saginaw River.

Settled in 1822, it was incorporated as a city in 1857. Water-works were built in 1873 by the city after plans of the Holly Manufacturing Company, taking the supply from the Saginaw River and pumping directly into the mains by four piston pumps of 9 in. bore and 24-in. stroke, and two 10-in rotary pumps for fire pressure, driven by a Holly steam engine. The ordinary pressure is 45 and the fire pressure 95 lbs.

Distribution is by 2.4 miles of cast-iron and 6.6 miles of Wyckoff wooden pipe, of from 16 to 4 in. diameter, with 133 fire hydrants, 33 gates and 325 taps. Service pipes of lead and of iron are used. The population in 1880 was 10,525. The daily consumption is 1,000,000 gallons.

The works have cost $175,000. The bonded debt is $150,000 at 8 per cent. interest. The expenses in 1881 were $10,067.19, and the receipts, $3,500.

The works are managed by a Board of Commissioners.

D. C. Dixson is the Superintendent.

CCCCXXVII.—TIFFIN, O.

Tiffin, Ohio, in lat. 41° 10′ N., long. 84° 15′ W., is on level ground on both sides of the Sandusky River. Settled about 1810, it was incorporated as a city in 1850. Water-works were built in 1879 for a private company by the Wiley Construction Company, taking the supply from the Sandusky River and pumping directly into the mains by four piston pumps, driven by a 72-in. turbine under 8 ft. head. A dam, 230 ft. long, furnishes the water-power. There are also two direct acting steam pumps for use when water is low.

The ordinary pressure maintained is 50 lbs. and the fire pressure 80 to 150 lbs.

Distribution is by 15 miles of pipe of from 16 to 4 in. diameter, chiefly of cast iron, with some wrought iron. The pump works are on the north side of the river, a mile above the centre of the city. The river is crossed by a 16-in. main at the pump house, and a 12-in. pipe near the centre of the city. A 16-in. main is laid down the south shore and a 10-in. main down the north shore.

There are 103 fire hydrants, 50 gates and 400 taps. The city pays $50 per year each for 98 hydrants and $75 per year for each additional one. Service pipes are of wrought iron.

The population in 1880 was 7,875. The daily consumption is 273,000 gallons.

No financial statements are given. Walter Burnham is President of the company, and M. Scammel, Secretary and General Manager.

CCCCXXVIII.—RICHMOND FURNACE.

Richmond Furnace, Massachusetts, in lat. 42° 22′ N., long. 73° 23′ W., is on both sides of Centre Brook on irregular ground, generally sloping to the west for a mile to Stockbridge Ponds, which are 760 ft. above sea level.

The town was settled in 1760. The village is not incorporated.

Water-works were built by the Richmond Iron Works in 1882, after plans of William E. Petee, C. E., taking the supply from Centre Brook, which is fed by the Richmond swamps, 1,170 ft. above sea level and 1½ mile above the point at which the water is taken. A dam 100 ft. long and 8 ft. high, of stone masonry, forms a reservoir of ½ acre area. A chamber 6 by 12 ft. in the dam, is filled with gravel and charcoal layers between wire screens. Through these the water is filtered and enters a 6-in. cast-iron main leading to the village, 4,000 ft., with a fall of 53 ft. and a rise of 40 ft. at a summit on the route. The reservoir is about 20 ft. above the tops of the highest houses in the village. There is also ½ mile each of 3-in. cast and 2-in. wrought-iron pipe, the extreme head on which is 90 ft. Water is furnished to the company's shops and stables, the railroad station and 50 houses owned by the company. R. A. Berget is the General Manager of the company's works.

CCCCXXIX.—LAS VEGAS.

Las Vegas, New Mexico, in lat. 35° 35′ N., long. 105° 20′ W., on the Gallinas River is in the middle of a broad valley, 12 miles long at the foot of the Rocky Mountains.

Settled in 1844, it was incorporated as a city in 1882.

Water-works were built in 1882, for a private company, by Russell and Alexander, taking the supply from the Gallinas River which receives the drainage of 24 square miles of mountains.

A dam of timber, stone and clay, 6 miles from and 350 ft. above the city, impounds the water of the stream. There is on the shore, a crib 6 ft. wide, filled with stone and sand, through which the water passes to a well, whence it is conveyed through 100 ft. of 12-in pipe to a series of settling reservoirs in 6 compartments, 100 by 25 ft. Cast-iron pipe 10 in. and 8 in. in diameter lead to the city.

Distribution is by 12 miles of cast-iron pipe of from 8 to 4 in. diameter with 30 fire hydrants and 300 taps. The city pays $2,400 per year for use of hydrants. Service pipes are reported as of cast-iron.

The population is reported as 6,000 in 1882.

The capital stock of the company is $200,000. The works have cost $110,000. The expenses in 1882 have been at the rate of $3,000 per annum and the receipts at the rate of $9,000 per annum.

L. P. Brown is the President and W. S. Smith the Superintendent.

CCCCXXX.—WALLA WALLA.

Walla Walla, Washington Territory, in lat. 46° 5′ N., long. 118° 22′ W., is on Mill Creek in Walla Walla Valley, nearly surrounded by the Blue Mountains.

Settled in 1857, it was incorporated in 1862. Water-works were built by a private company in 1865, taking the supply from springs, the water from which is collected in two reservoirs holding about 240,000 gallons each.

Distribution was at first by wooden pipe, for which riveted wrought-iron pipe has since been substituted. There are 8 miles in use, of from 10 to 3 in. diameter, with 20 gates and 250 taps. There are no fire hydrants. Service pipes are of wrought-iron. The population in 1880 was 3,500. The consumption is not known.

The capital stock of the company is $150,000. The works have cost $100,000. The bonded debt is $55,000. The expenses in 1881 were $1,800. The receipts are not given. J. C. Isaacs is Secretary and J. F. Bowman the Superintendent.

CCCCXXXI.—HYDE PARK, VT.

Hyde Park, Vermont, in lat. 44° 36′ N., long. 72° 40′ W., is on irregular ground on the Lamoille River, which furnishes an important water-power.

It was settled in 1790; but the village has never been incorporated. Water-works were built by a private company in 1850, after plans of S. Niles, taking the supply from springs, the water from which is conveyed to and through the village by 5 miles of lead pipe of 1 in. and ¼ in. diameter. There are 50 taps and no fire hydrants. Lead service pipes are used. The population in 1880 was 1800. The consumption is not known.

The capital stock is $2,400, mostly owned by the water takers. The works have cost about $6,000. The annual expenses and receipts are $200.

Carroll S. Page is Secretary and Treasurer, and A. P. Smalley General Manager.

CCCCXXXII.—MARION, IND.

Marion, Indiana, in lat. 39° 42′ N., long. 86° 30′ W., is on level ground on the Mississinewa River.

Water-works were built by the city in 1877 after plans of J. D. Cook, C. E., taking the supply from a well 25 ft. in diameter. The brick curb, built on a timber shoe, was sunk 26 ft. into a stratum of saturated porous gravel, by excavating from the inside. A pipe was then driven 42 ft. through hard pan into another water-bearing stratum, the water from which will rise 16 ft. above the surface of the ground.

The water is pumped directly into the mains by a Dean duplex steam pump with 18 in. steam and 10 in. water cylinders, of 14 in. stroke.

The ordinary pressure is 30 lbs., and fire pressure 80 lbs. There are 6 miles of cast-iron pipe of from 12 to 4 in. diameter, with 44 fire hydrants and 26 gates. The number of taps is not given. Service pipes are of galvanized iron.

The population in 1880 was 4,000. The daily consumption is not furnished.

The works cost $25,000. The bonded debt is $20,000. Further financial statistics are not given.

The works are managed by a Board of 3 trustees, Samuel Hulley is the Superintendent and B. R. Norman Clerk to the Board.

CCCCXXXIII.—THOMASTON.

Thomaston, Connecticut, in lat. 41° 40′ N., long. 73° 5′ W., is on irregular ground. Originally part of the town of Plymouth, it was set off in 1875

and named after the founder of the village, Seth Thomas, the clock manufacturer.

Water-works were built by a private company in 1880, after plans of W. B. Rider, C. E., taking the supply from a small stream, which receives the drainage of about 2 square miles. A dam 512 ft. long, built of earth with a rubble masonry heart-wall, forms a storage reservoir of 37¼ acres area, holding 60,000,000 gallons, at 318 ft. above the village, and 1¼ miles from it. A filter chamber is constructed in the dam with sponge and charcoal, but is not entirely satisfactory.

A 10-in. cast-iron pipe conveys the water to the village, and the distribution is by 5 miles of cast-iron pipe from 12 to 4-in. diameter, and 1 mile of wrought-iron of 2 in. and 1 in. There are 33 fire hydrants, 28 gates and 140 taps. The town pays $600 per year for use of hydrants Service pipes are of galvanized iron.

The population in 1880 was 2800. The consumption is not known.

The capital stock of the company is $30,000. The works have cost $39,000. No further financial statements are given.

W. T. Woodruff is Secretary and Treasurer and Nelson Bennett, Superintendent.

CCCCXXXIV.—ABILENE, KAN.

Abilene, Kansas, in lat. 38° 52′ N., long. 97° 20′ W., is on level ground on Smoky Hill River.

It was settled in 1868. Water-works were built in 1882, by a private company, after plans of Mr. C. Orton, taking the supply from a well 20 ft. in diameter and 40 ft. deep, in porous saturated gravel. The water is pumped directly into the mains by a Gaskill duplex engine of 1,000,000 gallons capacity, constructed by the Holly Manufacturing Co. The ordinary pressure is 30 lbs. and the fire pressure 80 lbs.

Distribution is by 1 mile of cast-iron pipes of 10, 8 and 6 in. diameter, with 17 fire hydrants and 4 gates. The number of taps is not given. The town pays $100 per year for each hydrant. Service pipes of lead and of iron are used.

The population in 1880 was 2,700. The daily consumption is not known yet.

The capital stock of the company is $30,000. The works have cost $25,000. The bonded debt is $25,000. The expenses have so far been at the rate of $1,680 and the receipts $2,700 per year. J. E. Bonebrake is President and Superintendent.

CCCCXXXV.—ITHACA, N. Y.

Ithaca, New York, in lat. 42° 30′ N., long. 76° 30′ W., in a valley at the head of Cayuga Lake, surrounded on three sides by hills from 400 to 1,000 ft. high, is built partly on the flat and partly on the hillsides. It is the seat of Cornell University. Settled in 1789, it was incorporated in 1821. water-works were built by a private company in 1872, after plans of Isaac S. Cassin, C. E., taking the supply from Buttermilk Falls Creek, which has a watershed of 10 square miles.

At 3 miles from the village, and 500 ft. above it, a dam of cribs of white pine timber, filled in with small stones, grouted with cement forms an impounding reservoir holding 10,000,000 gallons. The water from this flows down the bed of the stream for one mile to another and similar dam, 212 ft. above the village, where 1,500,000 gallons are impounded. Some of the higher parts of the village are supplied directly from this reservoir. The main supply is conveyed 2 miles by an 8-in. cast-iron pipe to the distributing reservoir, which is 146 ft. above the village and holds 1,350,000 gallons. It is on a side hill, on rock foundation, and built of stone masonry, laid in cement, lined with brick and backed on the outside with earth, supported by a stone retaining wall. The bottom is covered with 18 to 24 in. of concrete.

Distribution is by 10 miles of cast-iron pipe of from 20 to 4 in. diameter, with 35 fire hydrants and 115 gates. The number of taps is not given. The village pays $75 per year for each hydrant. Service pipes are of lead and of galvanized iron, the latter being principally used now.

The population in 1880 was 9,140. The daily consumption is not given.

The capital stock of the company is $100,000. The works have cost $156,000. The bonded debt is $56,000 at 6 per cent. No further financial statistics are given.

Leonard Treman is President and E. M. Treman Secretary.

CCCCXXXVI.—PARKDALE, ONT.

Parkdale, Ontario, Canada, in lat. 43° 39′ N., long. 79° 28′ W. is on ground gently sloping to the shore of Humber Bay, Lake Ontario. It was incorporated as a village in 1879. Water-works were built by the village after plans of Walter P. Huron, in 1881–82, going into operation in March. The supply is taken from Lake Ontario. A double crib of 12-in. timbers, 40 ft. square outside and 20 ft. inside, with the intervening 9 ft. filled with gravel, is sunk in the lake in 16 ft. water. The water is taken from the interior well of the crib through a 12-in cast-iron suction pipe 687 ft. long, on the lake bottom, with flexible joints, to the pump house, whence it is pumped directly into the mains by a Perkins pump of 8-in. water and 14-in. steam cylinders, of 12-in. stroke. Its nominal daily capacity is 2,000,000 gallons. The ordinary pressure is 75 lbs. and fire pressure 115 lbs. at the pumps. The highest ground in the village is 87 ft. above the lake.

Distribution is by 7.6 miles of cast-iron pipe of 10 to 4-in. diameter, with 55 fire hydrants and 47 gates. The number of taps is not given. Service pipes are of lead.

The population is 1,100, and the daily consumption 55,000 gallons.

The works have cost $49,000. The bonded debt is at 6 per cent. interest The receipts for 1882 were $800; expenses not given.

John Patrick is the Superintendent.

CCCCXXXVII.—LONGMONT, COL.

Longmont, Colorado, in lat. 40° N. long. 105° W., on the St. Vrain River, is on undulating ground, with a gentle slope to the eastward. Settled in 1870, it was incorporated as a town in 1873. Water-works were built in 1882, by the town, after plans of Daniel Ransom, taking the supply from the St. Vrain River, which receives the drainage of the Rocky Mountains and the base of Pike's Peak.

A well is sunk on the river bank, 9 miles from the town. From the well an 8-in. pipe is laid for a few feet, and from this a filter culvert is laid under the bed of the stream. It is a stone box culvert, 2 ft. wide and 1 ft. high, covered with 2 ft. of sand and gravel. From the well the water is conveyed 8 miles in a 6-in. wrought-iron pipe to a reservoir or cistern, in excavation with brick walls and floor, holding 665,000 gallons at 112 ft. above the town.

Distribution is by 4 miles of special light wrought-iron pipe of 8 in. to 3 in. diameter, with 26 fire hydrants and 50 gates. The number of taps and the daily consumption can not be given yet. Service pipes are of galvanized iron.

The population in 1880 was 800, and in 1882 was 1,200. The works have cost $65,000. The bonded debt is $20,000 at 8 per cent. interest.

The works are managed by the trustees of the town.

CCCCXXXVIII.—WESTERN N. C. INSANE ASYLUM.

The Western North Carolina Insane Asylum has been in course of construction since 1876, near Morgantown, in lat. 35° 43′ N., long. 81° 40′ W.

The water supply was provided for in 1876 by works built after the plans and under the superintendence of Roger P. Atkinson, C. E., the engineer of the Asylum. The supply is procured from Black Fox Branch, a tributary of the Catawba River, 4.7 miles from the institution.

Across a gorge in the mountains a dam 60 ft. long and 8 ft. high was built of coursed rubble masonry, on a footing of concrete 2 ft. thick and 2 ft. below the bed of the stream. The dam is backed with heavy rip-rap. Earth embankments extend the dam at each end. From a chamber in the dam, 3 ft. square, one 6-in. pipe is laid into the reservoir, and another 6-in. pipe conveys the water to the Institution. The pipes are of cast-iron. The storage reservoir holds 100,000 gallons, at 175.5 ft. above the Asylum.

The pipe was laid following the undulations of the surface, but nowhere rising above the hydraulic grade line. Air cocks are placed at summits and blow offs at depressions. The lowest point is 200 ft. below the reservoir. The pipe trenches were only 2½ ft. deep ordinarily. No sleeve connections were made, but closings were made by springing in the pipe. There were 5 lbs. of lead and ⅝ lbs. oakum used per joint. Except on very steep hillsides the trenches were kept open until the pipe was completed and tested under a head of water. The conditions under which this work was executed, in a wild and remote region, render the details of its cost of interest. Common labor was had for 60 and 75 cents per day and skilled labor for $1.50 to $3. The most economical distribution of labor in laying the pipe was as follows:

1 man in front making rests for end of pipe.
3 men handling and laying pipe in place in trench.
2 men calking oakum.
1 man preparing oakum in rolls.
2 men rolling and preparing clay.
1 man putting clay on joints.
1 man taking off clay.
2 men melting lead.
2 men calking lead joints.
1 man cutting off projecting lead.
16 men in all, who would, after the pipe was distributed alongside of trench, lay 120 to 150 pipe, 12 ft. long, in 10 hours.

The distribution of the pipe along the line, with an average haul of 6 miles, cost $1.73 per 2,000 lbs.

The minimum daily yield of the stream is 216,000 gallons, and the reservoir holds 100,000 gallons. The capacity of discharge of the pipe is said to be 345,000 gallons daily.

The detailed cost of the work was as follows:

Materials—		
2,104 6-in. pipe	$13,356.88	
Special castings	174.84	
9,185 lbs. of lead	856.32	
1,349 lbs. oakum	222.19	
Gates and air cocks	228.90	
Freight on pipes, gates, lead, etc	3,032.28	
Cartage of gates, etc	51.60	
Distributing pipes on line	688.45	
Total materials		$18,611.37
Less value of material left over		375.00
		$18,236.37
Laying—		
Trenching on back-filling, 28,400 ft	$1,067.40	
Labor laying pipes	456.73	
Labor setting valves, etc	78.75	
Total labor		$1,602.88
Total cost of pipe laid		$19,839.25
Land damages on pipe line		52.00
" " at reservoir		237.00
Dam and Reservoir—		
Labor	$377.23	
71 bbls. cement	132.50	
Freight and hauling	137.71	
		$647.44
Service Pipe—		
800 ft. of 1 in. pipe along building, with stops, etc.		121.56
Engineering		938.00
Total cost		$21,835.25

(TO BE CONTINUED.)

The receipt of statistics, as follows, is acknowledged with thanks: From B. R. Norman, Clerk to Water Board, statistics of Marion, Ind., water-works. From Lieut. R. L. Hoxie, U. S. A., Report of work on Washington Aqueduct, June 30, 1881. From J. L. Fisher, statistics of Tiffin, O., water-works. From J. C. Isaacs, Secretary, statistics of Walla Walla, Wash. Ter. W. W. From J. E. Bonebrake, President Water and Gas Co., statistics of Abilene, Kan., W. W. From A. F. Matlack, City Clerk, additional notes regarding Stubenville, O., W. W. From G. W. Howell, C. E., Report of Water Committee of Lebanon, Pa., November, 1882. From Nelson Bennett, Superintendent, statistics of Thomaston, Conn., W. W. From Leonard Treman, President, statistics and water rates of Ithaca, N. Y., W. W. From John Patrick, Superintendent, statistics of the Parkdale, Ont., W. W. From Daniel Ransom, statistics of the Longmont, Col., W. W. From Isaac S. Cassin, C. E., statistics of water-works of Newcastle, Del.

A WALL STREET MAGNATE.

Business in the Wall street commission offices is dull, yet there is at least one man who always makes money in the street; but then he is an exceptional being, and his resources are unfathomable. That man is the *Hon. Russell Sage.* His main income is from the sale of privileges. Never mind how dull the market may be or which way it goes, there are always people willing to buy puts and calls as a protection against big losses, and Uncle Russell is always ready to sell them, especially if the broker is a man of the world and treats him nicely. The other day one of them promised a customer to buy for him a ninety-days' put on 200 shares of Wabash preferred at 46. The stock was selling at 54, and the broker thought he was sure to get it. But Mr. Sage happened to be in one of his close-fisted moods and would not sell it above 45. The broker showed him two brand-new hundred dollar bills. But nothing seemed to work.

"I'll tell you, Mr. Sage, what I will do. I'll give you $200 in cash and send to your house a ten-gallon keg of Bass' ale for yourself and a basket of flowers for Madam. You would really oblige me by selling that put. I promised to get it for a good customer."

"Never mind the flowers," answered the old gentleman, somewhat less harshly than he had spoken before—"Never mind the flowers. I don't want no flowers. Send me something else. Send me a gallon of good Keystone whisky. You know where to send it—506 Fifth avenue. Give me that money and go and make out the put."

The broker's commission was only $10, while his bill for the keg of Bass and the demijohn of whisky was $15.85; but he was delighted at being enabled to accommodate his customer. When the bargain was afterward related at Delmonico's another broker retorted: "Why, there is nothing new in that. I have been keeping the old fellow in groceries for two or three years past. But there is one thing to be said about Sage. If you spend a dollar on him you are almost sure to make $10, and if you spend $10 you make $400. I think if anybody had the pluck to spend a few hundred and buy him a horse or something of that sort, he would make his fortune, provided the old man did not jump the game after he got the horse."

Mr. Sage is supposed to be worth $20,000,000, and his fortune has been accumulated solely by this kind of strict personal attention to the details of all business transactions. He is one of the thirty New Yorkers whose joint wealth is estimated at over one thousand millions of dollars, and would probably be still larger were they all like him.—*N. Y. Sun.*

ENGINEERING NEWS
AND
AMERICAN CONTRACT JOURNAL.

Tribune Building. New York City.

GEO. H. FROST.....EDITOR AND PROPRIETOR.
S. D. V. BURR.....ASSOCIATE EDITOR.

SATURDAY, DECEMBER 16, 1882.

EDITORIAL ANNOUNCEMENTS.

Terms of Subscription.—To the United States and Canada, $4 per annum, including postage; all parts of Europe, $5, payable in advance. Remittances at the risk of the subscriber, unless made by registered letter or by draft, check or P. O. order, payable to GEO. H. FROST.

Terms of Advertising.—One inch, 12 lines, one insertion, $2; one month, $6.50; three months, $17; six months $30; one year, $50. Special rate for large space and long time will be given on application. Advertisements inserted for less than three months, payable in advance; for longer time, payable quarterly.

Articles for Publication in the current number should be received at the office of publication not later than Thursday morning, and advertisements not later than Friday noon.

Correspondence upon subjects which naturally belongs to the province of this journal is solicited.

CLUBBING ARRANGEMENTS.

1883.

In order to accomodate such of our subscribers as may wish to subscribe for other periodicals we offer the following terms: We will send to any address ENGINEERING NEWS at regular subscription price, $4.00, and the following at the additional prices given:

	Net Price.	Reg. Price.
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" " (renewals)	3.90	4.20
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Our Continent	3.25	4.00

The principal change in the above figures from those of last season is in that of the *Century Magazine*, which has advanced its trade price correspondingly. Our purpose is to bring the trade of our subscribers into this office, and to do this we give the clubbing journals at trade price and we add five cents to pay for stamps, stationery and time in handling the business. We wish it understood that we will extend this arrangement to any desired journal in the United States, so that our subscribers need not pay any attention to the claims of solicitors, who cannot offer any better terms.

CONTENTS.

	PAGE.		PAGE.
CORRESPONDENCE:		EDITORIAL DEPARTMENT:	
Ship Building (*Illustrated*)	427	Notes	430
Earthwork Calculations (*Illustrated*)	427	Bogus Inventors	430
Difficult Earthwork Measurements	428	A Hydrogen Gas Company	430
Longest Tangent	428	Personal	430
The History and Statistics of American Water-Works	428	London Correspondence	431
A Wall Street Magnate	429	Hods	432
		How to be Weather Wise	432
		The Keely Motor	432
		The St. Gothard Railway	432
		General Intelligence	432
		Truss-Bridges (*Illustrated*)	433

NOTICE OF MEETINGS.

AMERICAN SOCIETY OF CIVIL ENGINEERS, 127 East Twenty-third street, New York. The thirtieth annual meeting of the society will be held in New York, on Wednesday, Jan. 17, 1883, at 10 A. M. The annual reports will be presented, officers for the ensuing year elected, time and place for the next annual convention considered, proposed amendments to the constitution discussed, and other business transacted. Arrangements for Jan. 17 and 18 will be perfected by a committee, and you are invited to be present at the meetings on those days.

"EXCAVATING WET MATERIAL BY HYDRAULIC PROCESS" is the subject of the paper read before the last meeting of the Western Society of Engineers by J. C. Dodge.

President CHARLES LATIMER of the International Institute for Preserving Weights and Measures, says that "The object of our association is to preserve the records of the past, in our hereditary weights and measures, and by digging into the monuments of the past to understand the origin of the weights and measures that we have. In this investigation we are led into the subject of races and nations, and it opens one of the widest fields of investigation and research. We claim that the great pyramid of Ghizeh holds within it the whole subject of the weights and measures of the Anglo-Saxon race, and our investigations are in that direction at present. We believe that it not only holds this, but also an epitome of all the sciences known to the race of man."

BOGUS INVENTIONS.

Letters patent protect two classes of individuals occupying the extremes in the inventing world. First, those who study a subject with the intention of honestly improving it; second, those who study the movements of the first class and steal everything they can. All honor is due to the honest man who, by patient experimenting, close application, deep study and much expenditure, produces a device destined to make more subservient the forces of nature. This man makes himself familiar with what has been accomplished in the particular branch to which he is devoting his attention, and then seeks to push it another step toward perfection. We cannot throw our glance to any point in the civilized world without meeting overwhelming evidences of his unremitting labor.

The deepest contempt should be manifested toward the second class, which, we are sorry to say, is much too numerous. This class may be further divided into those who, becoming suddenly convinced that they have an all-important machine or even a single part of a machine, rush to the patent office for protection. In the majority of cases these devices have not been practically tested, nor even theoretically demonstrated, their merits and demerits are only guessed at and the mere supposition that they might be of use in some part of a work, has led the seeker after "royalty" to protect them. The second division steals the work of the honest inventor. The smallness and apparent insignificance of these things never effect the zeal of the pirate. His attentions are given to the big and the little; sometimes the latter is preferred.

From these simple facts has arisen the holy horror in which every honorable member of the profession holds these people, and the dread he has of showing the result of his work before he has filed his claims for fear his idea of a bolt of peculiar construction may be stolen. The thief knows that a machine which would do that particular work successfully would be valuable; he also knows that peculiar bolt is vital; consequently, if he can control the use of the bolt, he has, practically, the controlling use of the whole thing. The only redress is now in the courts, and as the choice between the thief and his royalty and the lawyer and his fee is about even, a compromise is effected, and the peculiar bolt has made the fortune, not of its creator, but of its owner.

The holders of patented devices, which have not been recognized as undoubtedly the best, pursue two courses to obtain the approval of their machines, either in works of great magnitude or where they are of such a high character as to make a reputation for any article used in their construction. One is in the case of work let by contract to have the device adopted by the promoters and made compulsory by the specifications. But failing in this the patentee goes to the successful bidder and tries to bargain with him for the use of his invention. We were informed of an instance this week where a contract had been let for a certain number of cars, the specifications being very carefully drawn. Two men holding patents and having failed to influence those in charge, posted off to the builders the instant the award was made public.

For these many reasons projectors and builders are very loth to publish detailed drawings, or even complete descriptions of their devices before the whole thing has been put in working order, and they are very careful to whom they even briefly describe their endeavors.

Give this class of inventors the merest inkling that you are trying to do certain things, which if successful will pay, and they will file claims on every possible method and every detail. They work on the principle that the device may possibly be a part of your own, and if so, and you can not devise something instead you are at their mercy. The idea of making practical tests and carefully experimenting, and working from a few disjointed ideas up to a completed whole, expending time and money with but one object in view, never enters their heads; and if an honest ambition, seeking a place of lodgement, should stray in, the uncongenial surroundings would quickly smother all its fire.

A HYDROGEN GAS COMPANY.

The Equitable Gas Company has asked permission of the Gas Commission of this city to erect works and lay mains under the streets. They will agree to furnish gas of not less than 25 candle power at a rate not exceeding $2 per thousand to private consumers, and $16 per lamp for street lamps burning 3,883½ hours, consuming three feet per hour at a pressure of one inch. The company was incorporated March 9, 1882, with a capital of $2,000,000.

The President of the company stated that pure hydrogen gas would be used, and that the method of manufacturing it cheaply was invented by the late Tessie Da Motay.

The calorific properties of hydrogen are greater than those of any other substance; when carbureted it forms an illuminant of great brilliance, and the products of combustion are harmless. Owing to the many uses it could be put to, almost innumerable have been the efforts to produce it in large quantities and at a comparatively small cost. The most general plan, and one which has attracted attention for years, is the decomposition of water by bringing it in contact with a substance having a strong affinity for the oxygen, thereby liberating the hydrogen. Nearly all the cheap compounds in which hydrogen appears as an element have been experimented upon with only this object in view. So far the cost of obtaining the gas has been in excess of the value after obtained, and for this reason the devices have failed of adoption, although practicable.

The Equitable Company propose to obtain hydrogen by the decomposition of steam and liquid hydro-carbon in contact with highly heated lime. A nearly pure gas can be obtained in this way, and after having been carbureted gives an illuminating power of from 30 to 50 candles. In this process no loss is occasioned in the lime, as it is being continually revivified by heat. The success of the plans depends entirely upon the cost, and as it is the first attempt upon so large a scale to utilize hydrogen, every step will be watched with keen interest, should the city grant them the privilege.

Some years since it was proposed to obtain hydrogen by passing steam through coils of pipe containing small pieces of iron. An oxide of iron resulted and pure hydrogen obtained. But it was found that the oxygen bestowed its favors as liberally on the conducting pipes as it did on the refuse iron, and renewals were too frequently needed. Although the plan worked admirably, the running expenses were out of all proportion to the benefit derived, and the idea was abandoned only to be revived again and again in following years with few or no attempts at changes, and as a suitable substitute could not be found for the iron pipes, the old result occurred.

PERSONAL.

MR. WM. F. BLAKENEY, the inventor of the turbine water wheel, died at Dayton, O., on Saturday night the 9th.

DAVID H. COYLE has recently been elected Chief Engineer of the Water Department of Wilmington, Del.

AUSTIN LATHROP, an extensive railroad contractor, of Corning, N. Y., has been appointed Commissary General of Subsistence on Governor CLEVELAND'S staff.

MR. GEORGE B. N. TOWER, Supervising Inspector of Steam Vessels for New York and New England, has been superseded. Mr. TOWER is the author of a little book on American bridges.

ATTORNEY GEN. MARSTON, as representing the

Commonwealth of Massachusetts, was in Rhode Island last week before Commissioners appointed to determine the boundary line between Massachusetts and Rhode Island.

GEO. S. FIELD, President of the Central Bridge Company, of Buffalo, has been appointed Engineer-in-Chief of Governor-elect CLEVELAND'S staff. Mr. FIELD is an accomplished engineer and has a very large acquaintance in this city and State.

H. C. LOWRIE was re-elected to the office of City Engineer of Denver, Colo., for the sixth time on the 5th inst. Mr. LOWRIE was appointed Chief Engineer of the Denver & New Orleans Railroad on April 1, 1881, and he held that office and the office of City Engineer of Denver until Nov. 15 of that year, when the term of the city office expired, and he was not a candidate for re-election, Mr. E. H. KELLOGG being elected. During the past year Mr. LOWRIE has had charge of the construction of 140 miles of railroad, and the location in great part of nearly 400 miles of main line. He has resigned his position in the railway to accept the city office. Mr. LOWRIE devised the sewerage system of Denver, and under his charge the sewers were built.

HENRY T. BOVEY, M. A., Asso. Mem. Inst. C. E., Mem. A. S. C. E., Professor of Civil Engineering and applied Mechanics, McGill College, Montreal, will assume the editorial control of the *Canadian Magazine of Science and the Industrial Arts*, on January 1, ensuing. The journal has heretofore been known as the *Scientific Canadian*, and it is the official gazette of the Canadian Patent Office. The proprietors, the Burland Lithographic Co., 5 and 7 Bleury street, Montreal, intend to do all they can to add to the interest and value of the magazine. The first number will contain, among others, articles on Technical Education, by J. Clarke Murray, LL.D.; on Cable Traction for Tramways and Railways, by C. F. Findlay, M.A., Associate Mem. Inst. C. E.; and on the Transit of Venus, by Alexander Johnson, LL.D.

LONDON CORRESPONDENCE.

SPECIAL TO ENGINEERING NEWS.

LONDON, Dec. 2, 1882.

In opening my correspondence to-day I may be excused for dwelling shortly on the general conditions of trade prevailing at present in England. The prospect is less favorable than it was a few months ago, and the Board of Trade return for October disclosed a decided pause in the progress of our exports. The next return, which is expected on Dec. 8, is looked for with some anxiety, and I shall probably have to place before your readers an even more unfavorable statement. At any rate, with the prevailing depression in the iron trade on your side, exports hence will probably again have fallen off, while trouble is apprehended in the textile trades. On the whole, a fairly active business is progressing, and it is thought with moderate profits; but the prevailing financial weakness, which has partly its origin on the Paris Bourse, imparts an uneasiness to our markets which is intensified at every depressing feature which may occur. Thus the unfavorable report on the American iron and steel trade at once produced increased dullness here, and the hopes of a boom in the States which were entertained in many quarters were thus dispelled. Generally speaking, however, it is hardly to be supposed that the cycle of progress which set in after the long lasting depression has already run its course, and it may be fairly hoped that only a momentary check has been experienced.

In our building trades considerable activity is displayed. In the metropolis, as well as in the large prominent towns, numerous old buildings are being pulled down and new ones erected. The new Law courts which will be opened by the Queen on Monday next form a magnificent gothic structure. Many, however, grumble at the slate roofs which the architect has introduced, and which certainly are the reverse of picturesque. It is suggested that red tiles would have greatly relieved the otherwise very sombre structure. Speaking of roofs I may mention the manufacture of a new material known as "vitreous iron plates," and which it is asserted will supersede galvanized iron, is about to be commenced at Derby. The patents originated in the mode of applying vitrified or enamelled plates to the bottom of ships and other submerged substances. After many trials the patents were secured for iron houses and the roofing of buildings, as also for the lining of water tanks, beer barrels, etc. The great dock at Poplar has been completed by the Midland Railway Company, thus bringing the mines of the North and the Midland into direct railway communication with the River Thames. The work has been on hand for four and a half years. An Irish engineer, Mr. Charles King, has come forward with the startling scheme of connecting Great Britain and Ireland by land. In a pamphlet, accompanied by a chart, he explains his proposal to construct an isthmus of the average width of 100 yards between the headland of Cartage in Scotland, and Tersor Point in Ireland, a distance of 19 miles, while the depth of the sea is 474 ft. deep at mid current. The cost of the isthmus is estimated at about £2,000,000. The scheme otherwise is so exceedingly wild and useless that John King will not find anybody to take it up.

The metal markets are at present in a very dull condition. Even copper, which is said to be so largely used in the electric industry, has relapsed £66 2s. 6d.@£66 12s. 6d. for Chili Bars cash. Lead and Spelter are quiet. Of the dullness of the iron trade I have already made mention. The ring in pig iron between Scotch and North of England makers is broken up and prices have suffered, warrants of Scotch pig iron having receded in Glasgow to £48 5s., but the full effects will hardly be felt until we are well in the winter, when as a rule exports slacken and stocks increase. Stocks in Glasgow are moreover very heavy. They stood at the end of last year at about 940,000 tons, and up to now, notwithstanding the restrictive movement, this immense store has only been reduced by some 12,000 tons. Ship building is not quite so active as before, but sufficient orders for vessels are in hand to provide remunerative work for some time to come. Bridge builders, locomotive makers, wagon builders, engine and boiler makers, etc., are also full of work. On the other hand, manufacturers of rails complain, and are endeavoring to form an alliance to improve their position. That the continuance of orders going to England from the United States is very small appears now pretty certain unless prices on your side should rise considerably, which is not likely. Taking the cost of English steel rails, including present low freights to New York and insurance at, per ton, £6 5s. 6d. ($30.50), and the import duty in United States, £5 15s. 6d. ($28), we get at the figure of £12 1s. ($58.50), while the present price of American rails at works is $40. India and the colonies may for the present only replace American orders; but as a number of new mills in different parts of Great Britain are about to be started, the already existing productive power of about 1,500,000 tons will be increased by further 300,000 tons per annum.

The following is a report on the London market as far as of interest to your side:

STEEL AND IRON.—Steel rails, f. o. b. usual ports. The market does not present any new feature, price remaining nominally as below, £5@£5 5s. per ton f. o. b. Cumberland ports; £5 7s. 6d.@£5 17s. 6d. f. o. b. Wales and Middlesboro'; according to weight, sections and specification. Old rails do not command any attention, except for consumption at home, the nominal prices, f. o. b. home ports, are O. D. heads. 72s. 6d.@75s. per ton; flanges, 65s.@67s. 6d. per ton; bridge about 70s. per ton. Iron rails, f. o. b. usual ports, nothing doing. Heavy wrought scrap-iron, 60s.@62s. 6d. per ton net cash, f. o. b. London and out-ports. Old railway leaf spring steel, c. i. f. usual ports, £5@£5 2s. 6d. per ton, but nothing doing. Steel blooms, 7 in. by 7 in. and upward, f. o. b. usual ports, £4 12s. 6d.@£4 17s. 6d. per ton, but no inquiry. Bessemer pig-iron, Nos. 1, 2 and 3, f. o. b. usual ports, very flat at 55s. per ton and over according to brand. Bar iron, f. o. b. Wales, common qualities and ascortments, £5 10s.@£5 15s. per ton. Crop ends dull at 60s.@62s. 6d. per ton f. o. b. Wales.

It is stated that M Lazare Weiller, of Angoulene, has at length found a suitable material for telegraphic purposes analogous to phosphorbronze, which is used for telephone wires, but has not sufficient conductivity for telegraphic purposes. The new material is silicious bronze, in which the deoxidant consists of a silicious metalloid that produces a better conductor than the phosphorus. The results of experiments are said to have been very satisfactory.

Italy has been spending public money very freely of late in the construction of public works, the budget now standing at £12,200 000, as against £6,000,000 in former years. Already the length of railways in operation has increased from 5,100 miles in 1878 to 5,700 miles, and since 1778, 347 locomotives, 850 carriages and 5,714 wagons have been bought.

Messrs. Craven Brothers, of Manchester, are at present engaged on two orders for the complete equipment of locomotive tools capable in each case of turning out 50 locomotives per annum—one for the Canadian & Pacific Railway Company and the other for the Franco-Belgium Works. They have also orders on hand for 28 large traveling cranes, ranging up to 30 tons.

THE FORTH BRIDGE.—Preparations are now being made with activity, in order to enable the contractors for the construction of the Forth Bridge to begin work as soon as the condition of the weather will allow them to do so. The works for brick-making, tradesmen's shops, stores and plant prepared for the former contract held by Messrs. Arrol & Co., Glasgow, are being rendered available again; so that in this way there will be a considerable saving of time. Sir Thomas Tancred, of London, one of the contractors, has taken a lease of premises in South Queensberry for five years, the time within which it is expected that the great undertaking will be completed.

The present statistical position of pig iron is shown by the following figures:

Furnaces in blast in Scotland, 114, against 105 on Dec. ?, 1881.

	Dec 1. Tons.	Nov. 24. Tons.	Dec.1, 1881. Tons.
Stock of pig-iron in Connell & Co.'s stores at Glasgow	612,867	615,935	620,005
Decrease for the week.. ..	3,068		
Stock of pig-iron in Connell & Co.'s stores at Middlesbrough	100,861	100,961	176,066

Shipments of total of Scotch pig-iron from Dec. 25 until Nov. 25—

	Tons.		Tons.	Total tons.
1882—Foreign.....	408,875	Coastwise ..	174,230	582,105
1881—Foreign.....	347,267	Coastwise ..	181.333	528,600
Total increase in 1881.....				545,051

According to the *Bulletin des Adjudications* (Paris, November 23), the Austro-Hungarian Government has made an arrangement with several French bankers (who are proprietors of Hungarian patents for mining and crushing machinery), under which the latter are to develop the gold mines of the country. The necessary staff and plant are to be provided by the Government, and the syndicate is to hand over to it the same quantity of ore as was being raised at the time of their commencing work, any surplus output being divided in certain proportions between the two parties. It is believed that this system of working will greatly tend to the full development of the Government mines.

THE SOCIETY OF ENGINEERS.—The Council of the Society of Engineers have made arrangements for three courses of lectures to be delivered in the hall of the Society during the present winter season. The first of the series, "On Strains in Ironwork," will be by Mr. Henry Adams, professor of engineering at the City of London College, and will comprise eight lectures, the first to be given on Thursday, Dec. 7, and the others on succeeding Thursdays to Feb. 1, 1883. The second course, "On Land Surveying and Leveling," will be delivered by Mr. A. T. Walmisley, and will also consist of eight lectures, beginning on Monday, Jan. 8, 1883, and continuing on successive Mondays until March 12. The third series, "On Water Supply and

Drainage," by Mr. R. W. Peregrine Birch, will begin on Thursday, Feb. 8, 1883, and be continued every Thursday until April 5. The special object of these lectures is to assist in the technical education of young engineers.

The *Gaceta de la Industria* (Barcelona, November 18), publishes the following statistics of the Spanish railways at the end of 1880: 4,656 miles were at work, for the construction of which subsidies amounting to 556,672,199 pesetas had been granted by the State. The shareholders' capital amonted to 533,691,416 pesetas, while the debentures issued by the companies showed a total of 1,085,369,507 pesetas. The number of passengers carried was 14,883,321, producing 46,374,097 pesetas. During the year 11,305,495 tons of goods were carried. These produced 94,541,374 pesetas. The rolling stock consisted of 1,245 locomotives of the united horse power of 439,053; 1,553 tenders, 3,669 carriages, and 21,949 goods wagons. B.

HODS.

Hods are of two kinds. One form of hod is devised for carrying bricks, and the other for the transportation of mortar. While differing somewhat in purpose and balance, the two species of hod are yet so closely allied as to be utterly indistinguishable when apart. Indeed, it is a matter of grave interest to men that during the whirl of centuries, when every other inanimate thing has, through the indomitable perseverance of invention been forced through a process of evolution that has robbed it of almost every semblance of its pristine nature, the hod remains to-day in structure, substance and design exactly as the hod originally was. At present hods are cheap. Eighty-four cents will purchase one. The cruze for all that is æsthetic, early English, Japanese' Etruscan or antique has passed by the hod unchallenged. The early Irish hod still reigns supreme.

The dimensions of a mortar hod are as follows: Length of bowl, 22⅜ in.; mean depth of bowl, 9½ in.; greatest width of bowl, 9¼ in.; height of back piece, 12⅜ in.; width of piece forming lateral sections of bowl, 11¼ in. The dimensions of a brick hod, it will be seen, are different. They are as follows: Length of bowl, 23⅛ in.; mean depth of bowl, 8 in.; greatest width of bowl, 8⅛ in.; height of back piece, 10¼ in.; width of pieces forming lateral sections of bowl, 8⅞ in. It is generally conceded that the mortar hod is built larger than the brick hod so as to make the weight when both are loaded as nearly equal as possible. The shank or handle is 4 ft. 2½ in. for each species of hod, and the shoulder rest is always 9 in. long, 3 in. wide, and 1¼ in. thick. This shoulder rest is attached to the inverted ridge-pole of the hod, and prevents the edge from cutting into the shoulder of the proprietor.

Touching the materials used in hod building, it may be said that the earliest ideas still obtain. Iron hods have been tried, but abandoned, because they were liable to rust and to become cracked when dropped six or seven stories by proprietors, who invariably, and instantly, relinquish all ideas and implements of labor at the stroke of 12 and and of 6. The verdict of ages is that the bowl of the hod shall be of yellow pine, and the shank a hickory pole with the bark on. In constructing a hod, it is found necessary to use thirty-three nails for the brick species, and twenty-nine nails and four screws for the kind intended for mortar. The screws are used in the latter instance to fasten the two arms of the shank to the bowl, because screws do not leave holes, as do nails, when they become loosened. Small holes allow mortar to escape, and are therefore open to objections. In making the bowl of a hod, eightpenny nails are used; fourpenny nails answer best for the shoulder rest, and shingle nails for securing a narrow strip of sheet iron that runs over the top of the back piece of the bowl for the purpose of impart additional strength. All of the nails are machine-made, with the exception of those used in fastening the shank to the bowl, which are hand-made and highly malleable. The mortar hod, besides having four screws, is lined at the seams with white lead. It has been considered somewhat superior to the brick hod. The weight of hods one hour after completion is ascertained to be exactly as follows: Brick hod, 9 lbs. 6 oz.; mortar hod, 10 lbs. 3 oz. Fifteen bricks are carried in the common hod.

There is a widespread impression that the shank of a hod is steamed after being split into the V shape necessary to accommodate the bowl. This is erroneous. The shank, after being split for a distance of 7⅝ in., is violently forced asunder by pressure against the wedge-like base of the bowl, and is secured while in that position.

Very many hods are owned privately, and many thousands more are owned by a large company up town, which makes hods and rents them to builders along with its patent hod elevators. The introduction of hod elevators, oddly enough, met with no opposition from individual proprietors of hods; but, on the contrary, was warmly welcomed by them. The elevators do the work of many men, but as building has increased in a satisfactory ratio, there has always been enough work for men who decided to adopt the hod as a means of advancement or sustenance. Indeed, so well have the individual hod proprietors in question adapted themselves to the existing state of things, that they absolutely refuse to climb higher than the second story now, and builders must, perforce, employ the elevators for stories of a loftier pitch.

At no time in the annals of the city has the hod industry been at a higher tide of prosperity. Thus the outlook for the hod is as bright as its history has been unvarying.—*N. Y. Sun.*

THE KEELY MOTOR.

AN EXPERT REPORTS THAT KEELY HAS DISCOVERED ALL THAT HE HAS CLAIMED.

PHILADELPHIA, Dec. 13.—The annual meeting of the stockholders of the Keely Motor Company was held this afternoon, at which the report of William Boekel, who was chosen by the stockholders and Mr. Keely as the custodian of his secret, supplemented by another report from Mr. Keely himself, was presented. Mr. Keely's communication says that his engine will soon be completed and in full operation, and that it is his purpose soon to bring the matter to the attention of the Pennsylvania Railroad Company with a view of having the engine first applied on their road between Philadelphia and New York. Mr. Keely assures the stockholders that he has passed the line of experiment and nothing is left to be done but the completion of the mechanical work now being done on his engine. He says in conclusion: "At your request and with the aid of Mr. Boekel and of counsel I have prepared a caveat for my generator, which has been forwarded to the Patent Office."

Mr. Boekel, in his report, after sketching the corporate existence of the company, treats of the great possibilities of natural forces, which, he says, Mr. Keely has been assiduously studying until the inventor's "investigations and experiments have carried him far beyond the laboratory experiments of such men as Prof. Tyndall and other scientific investigators, and he has succeeded in exciting, harnessing and utilizing the subtle force which to them has been only a subject of scientific wonder." Then he goes on to show that what Mr. Keely claims to have discovered is "the fact that water in its natural state is capable of being, by vibratory action, disintegrated, so that its molecular structure is broken up, and there is evolved therefrom a permanent expansive gas or ether, which result is produced by mechanical action. Very many of those to whom this communication is addressed have frequently seen at the workshop of Mr. Keely the evolution of this substance and its registry in a chamber, where it exerts an expansive energy of upward of 25,000 pounds to the square inch." The report does not describe the mechanism employed, as Mr. Boekel says that would be improper, but he concludes that Mr. Keely has discovered all that he has claimed, and that the stockholders should abide in patience the success of the enterprise. With respect to the great lapse of time since the announcement of the discovery and the practical utilization thereof, the report says that Mr. Keely has constructed three engines at different times, each being an improvement on its predecessor, but none of them equal to a fair test, but now he is engaged in the construction of a vibratory engine of 500 horse-power.

Mr. F. G. Green of New York, the treasurer of the company, submitted a statement of the financial condition. The disbursements of the revenue obtained by the sale of stock since December, 1879, are: 7,532 shares, $46,391.75; 1,500 shares paid to J. W. Keely on account of engine, 2,748 shares for loan of stock previous to consolidation, and the balance of the stock, 8,300 shares of the entire 20,080, is in the company's possession. The cash balance is $58.84.

At a special meeting of the stockholders, which was held prior to the general meeting, the question of reducing the number of directors from thirteen to seven was discussed and agreed to.

This afternoon the following directors were elected for the ensuing year: E. J. Randall, W. W. Wright, E. B. Haines, F. G. Green, R. Baldwin, George B. Collier, and J. J. Smith.

HOW TO BE WEATHER-WISE: A new View of Our Weather System. With Illustrations. By Isaac P. Noyes. 12mo., pp. 51; price, 25 cents. Fowler & Wells, Publishers, 753 Broadway, New York.

This is a brief and plainly-written explanation of the causes of changes in the weather, based upon the system of the United States Signal Service. It also explains the nature of that service. Comparatively few appreciate the value of the Weather Bureau, because its work is but little understood by the people who read the daily "Indications." Mr. Noyes shows how the data are obtained for these indications, and how simple a matter it is to observe weather signs, when the principle involved in weather movements is understood. Everybody, he claims, can observe the weather himself and be his own weather prophet, and, in good, square English, he indicates the way. Let those who would know how to be weather-wise send 25 cents in stamps to the above address and secure this interesting work.

THE ST. GOTHARD RAILWAY.

The opening of the St. Gothard Railway through the Alps has moved Consul Byers, of Zurich, to write a sketch of the great tunnel. The pass of that name is over the highest mountain chain in Europe. The old post-road, commenced in 1820, 7,000 ft. above the sea in places, was 18½ ft. wide. It crossed gorges, clung dizzily to steep mountain sides, and was roofed over where most threatened by avalanches. When the first railway was opened, in 1846, from Baden to Zurich, it was proposed to ask concessions to enable the company to attack one of the high passes, and in 1863, a union, or society, for the purpose was effected, upon the basis of an estimated cost of $37,400,000. In December, 1871, the St. Gothard Railway Company was organized, $6,800,000 stock and $13,600,000 of bonds was issued, a contract was made calling for completion in eight years, with a forfeit of $1,000 for each additional day and a bonus of $1,000 for each day gained upon the contract time. Work began in the summer of 1872, and it was soon discovered that the estimates were wrong, and that $57,800,000 would be needed to carry out the plan; a crisis followed, and the enterprise seems to have been saved only by what had already been invested in it, leaving no way out but to push ahead. The railway proper extends 113 miles from Immensee, in Switzerland, to Chiasso, in Italy, and more than one-fifth of the whole line is in tunnels—fifty-six in number; many of these are not straight, but actually spiral, accomplishing heavy ascents in short distances, and there are also many lofty viaducts, bridges and complicated galleries. The total length of tunneling is 23 miles. The main or great tunnel is 9¼ miles long, although others, exceeding 6,000 ft., might be thought noticeable elsewhere. The great tunnel is 26 ft. wide and 19 ft. high. The modern boring machines were worked by air compressed by large turbine wheels driven by the rapid River Reuss. The air was carried from the compressors outside to the bores within the tunnel in iron pipes of six inches diameter, and the escaping air served an indispensible purpose in ventilation; 3,500,000 ft. of compressed air were daily thus delivered and set free, pushing back and out of the tunnel the bad natural gases, with those set free by the dynamite and thrown off from animals and workmen. Fifty drills were worked; the usual daily advance was 21 ft., working from both ends, and the whole excavation was lined as fast as made with a circular tube of masonry 18 to 30 in. thick. The workmen were principally Italians, who worked eight hours a day, receiving 60 cents to $1.20 per day (mostly the former), boarding themselves, and living chiefly on meal porridge; yet most of them are reported to have saved and sent home to their families a part of this pittance. The tunnel cost 310 of their lives, and wounds were inflicted upon 877. The final actual cost of the tunnel and railway, exclusive of rolling stock, is now reported at something over $40,000,000.

GENERAL INTELLIGENCE.

☞ *We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.*

GAS AND WATER.

NORTH ATTLEBORO, MASS., WATER-WORKS.—Percy M. Blake, Civil and Hydraulic Engineer, of Hyde Park, Mass., on the evening of the 8th, presented to a meeting of the business men of North Attleboro and Plainville, plans and estimates for a water supply of those towns. It is proposed to take water from Bacon's pond, in Plainville, the pumping-engine to be located there: the reservoir, with a capacity of a half million gallons, is located on Watery Hill, 160 ft. above street level. The piping is estimated at 9.7 miles; total estimate expense, based on iron piping, is $111,341; for cement-lined pipe, $20,000 less. This includes everything pertaining to the water-works, in complete condition. In addition to the reservoir, Mr. Blake's estimate included an iron stand-pipe 50 ft. higher than the reservoir, for the purpose of furnishing a supply to those who have residences on the highest ground in the village. Hydrants are located on an average of 650 ft. the entire distance, and the supply, he guarantees, is sufficient for eight fire streams to be used at once if necessary. Letters were read from prominent responsible contractors who had offered to take the various contracts at figures less than the estimate made by Mr. Blake. The report was very gratifying and the estimate much below the ideas of many who have given the matter consideration. Steps will be immediately taken to draft a bill to present to the next Legislature, and an opportunity given to citizens to form a water-supply district or make it a private enterprise. Either way it

now looks as if the village, which is one of the most prosperous and goahead in the State, would have an excellent system of water supply before another winter.

BOSTON will not extend its high service water supply at present.

THE new engine of the Phœnixville, Pa., water-works is being put in place.

THE semi-annual cleaning of the 16 miles of conduit of the Boston Water-Works, between South Framingham and Chestnut Hill Reservoir, was begun Tuesday morning. About 40 men will be employed, and three days' time will be consumed.

BILLINGS, Mont., has had a meeting of citizens to discuss the subject of fire protection, and a committee has been appointed to see about the digging of wells and the purchase of a fire engine and the necessary hose. Mr. Geo. D. Rice, C. E., formerly of Boston, Mass., is one of the committee.

ELECTRICITY.

THE MAXIM ELECTRIC LIGHT is being introduced into the larger factories at Allentown, Pa.

STREETS, DRAINAGE, ETC.

F. THEODORE WALTON, who now has the contract for cleaning streets of this city, has offered to clean the streets of Philadelphia for five years for $500,000 a year.

WASHINGTON, D. C., will repave many of its old streets and open new ones during the coming year. The estimated cost is as follows:

Replacing wood pavements	$240,392.25
Replacing stone pavements	34,487.50
Laying new pavements	50,406.50
Grading and regulating	40,437.00
Total	$374,723.25

THE wood pavement of the Champs Elysees, in Paris, is being carried on at a rapid rate, and the portion between the Place de la Concorde and the Avenue de Marigny has just been completed. There cannot be two opinions as to the desirability of this improvement, as the sorry condition of the old carriage road formed a chronic topic of legitimate complaint.

RAILROADS.

THE Atlantic-Pacific Tunnel and Gray's Peak Railway Co. is the name of a new corporation formed for the purpose of building a railroad to the summit of Gray's Peak in Colorado, an elevation of 14,341 ft. above sea-level. The capital is $2,000,000, and the officers of the company for the first year are M. M. Pomeroy, President; L. C. McKenney, Vice-President; A. D. Whitaker, Secretary, and Douglas Washburn, Treasurer, with offices in Denver.

THE Reading Railroad is to be connected with the New York Central system by the construction of a road from Salamanca, the eastern terminus of the Erie Railway, to Williamsport, the western terminus of the Reading, and a traffic combination between Vanderbilt, Gowen and McHenry has been formed to divert trade over the new line between Buffalo and Philadelphia, leaving New York "out in the cold." To counteract these schemes, the Pennsylvania Central will build a parallel road to Reading.

BY the completion on the 11th of the new Milwaukee & Lake Winnepeg R. R., the Wisconsin Central R. R. gains an independent outlet from Milwaukee.

THE NEW YORK, WEST SHORE & BUFFALO RAILROAD COMPANY has contracted with Troy firms to furnish it 20,000 tons of steel rails, 67 pounds to the yard, at a few cents over $40 a ton, the rails to be delivered as wanted along the line of the road. Contracts for delivery of a large quantity of rails at Buffalo at the same rate will probably be effected this week.

IT is stated that the connecting link between the West Maryland and B. & O. railroads will certainly be built. Committees to solicit subscriptions are now at work.

NEW ROAD BUILDING.—The Grand Trunk is building a new air line to Detroit via Jackson, which will be twelve miles shorter than the Michigan Central.

THE MEXICAN NATIONAL.—On the 12th a section of 14 kilometers of completed road between Monterey and Santa Catarina, on the Coahuila Division of the Mexican National Railway, was examined by the official inspector and accepted on behalf of the Mexican government. Under the terms of the concession granting $7,000 per kilometer of accepted road the company will receive immediately $98,000. Track is already laid for sixteen kilometers south of Santa Caterina. The company has now 284 kilometers open for traffic in Northern Mexico, making a total on the Northern Division, from the port of Corpus Christi, Texas, to Santa Catarina, of 500 kilometers of completed road.

CORRECTION.—In the edition of Dec. 9, under the head of "A Pennsylvania Road," you have the name of the road wrong. Instead of *Conewago* it should be *Colebrook*. Part of the road follows the Conewago Creek, but the chartered name is the Colebrook Valley Railroad Company. I am connected with the road, and can therefore speak understandingly.

Respectfully, J. B. ROHRER.

THE Central Railroad of New Jersey will extend their line through upper Lehigh into Freeland.

A DISPATCH from San Diego, Cal., announces that ground has been broken for the Baja, California & Sonora Railroad. The contract for the first 20 miles has been let. The road will run through Lower California, crossing the Colorado river near its mouth, thence through Sonora to Calabazas, in Arizona.

A CORPS of engineers is surveying the proposed new line of railroad from Tamaqua to Williamsport, Pa.

IT is reported that the government is about to send an engineering commission under the direction of Dr. Carlos Alberto Morsing, to survey anew the route of the projected Madeira and Mamoré railway. The work, if it must be done, could not be entrusted to better hands.—*Rio News, Nov.* 15.

COMPLETED.—The Turkey River branch of the Chicago, Milwaukee & St. Paul Railroad was completed from Dubuque into West Union last Saturday.

ARTICLES of incorporation of the Fort Smith & Southern Railway were filed in Little Rock, Ark. The road will be fifty miles in length, and the capital stock $350,000, most of which is already subscribed. Waldron, Scott County, will be the southern terminus for some time.

BUILDING.

UNION DEPOT.—Mr. Minot, the engineer of the Boston & Providence Railroad, is perfecting plans for a union depot at Providence, to be occupied by the Boston & Providence, Providence & Worcester, Stonington, and New York & New England railroad companies.

THE architect of the new capitol at Albany was called to Columbia, South Carolina, to inspect the state-house and estimate the cost of completing it. He reported the building very unsafe, and showed that it is slowly parting in the center.

CONTRACTING.

THE steel rail mills of the North Chicago Rolling Mill Co., at South Chicago, were shut down on the 11th. The mills at North Chicago closed some time ago.

THE Delaware Rolling Mill, at Phillipsburg, N. J., was fired up on the morning of the 11th, after a month's idleness, but on account of a strike of the hands was closed down again during the day.

BOWERS, DUBE & Co., of Wilmington, are awarded the contract for 12 each, of long and short cars, for use on the Brooklyn Bridge, at $3,465 and $2,865 each, respectively. The contract for the boiler-houses and chimney for the Brooklyn side is awarded to W. H. Hazzard, Son & Co., at $18,818.

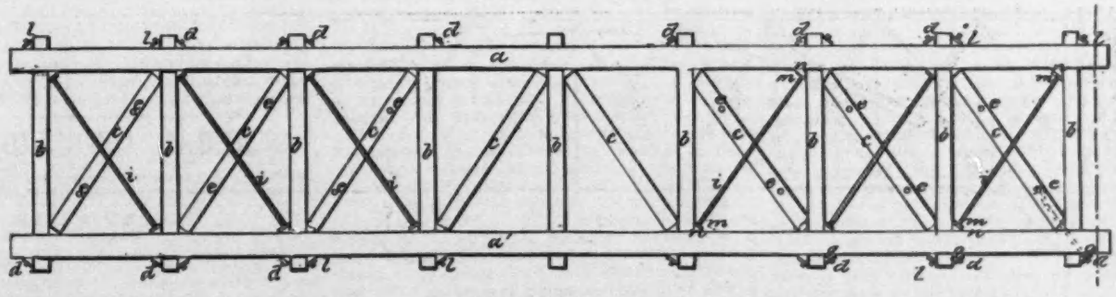
TRUSS BRIDGES.*

AN ILLUSTRATED HISTORICAL DESCRIPTION OF ALL EXPIRED PATENTS ON TRUSS BRIDGES, WHICH UNDER THE LAW ARE NOW PUBLIC PROPERTY AND FREE TO BE USED BY ANY ONE.

By F. B. Brock, Patent Attorney, Washington, D. C.

August 12, 1846, Horace Childs, of New Hampshire, received a patent for a truss-bridge. Childs employed suspension and cambering rods in such manner as to answer, in addition to these, the purposes of diagonal counter-braces, by using additional nuts above the lower and below the brace and an eye in the end of the bolts. The suspension rods, *i r*, have, in addition to the outside nuts *l l*, two nuts *m m*, that bear against block *n n*, below the upper and above the lower strings, so that by binding the chords and posts at top and bottom by means of these nuts, the rods answer the double purpose of suspension rods and counter-braces, and the same time binding the posts and chords.

August 12, 1846, Frederick Harbach, of Massachusetts, devised a bridge truss. The figures show a side elevation of a part of the truss and a vertical section of the same. The inventor makes use of hollow metallic cylindrical beams for the chords, braces and counter-braces. *A B* is the top chord, composed of two parallel cast-iron tubular beams,



CHILD'S BRIDGE.

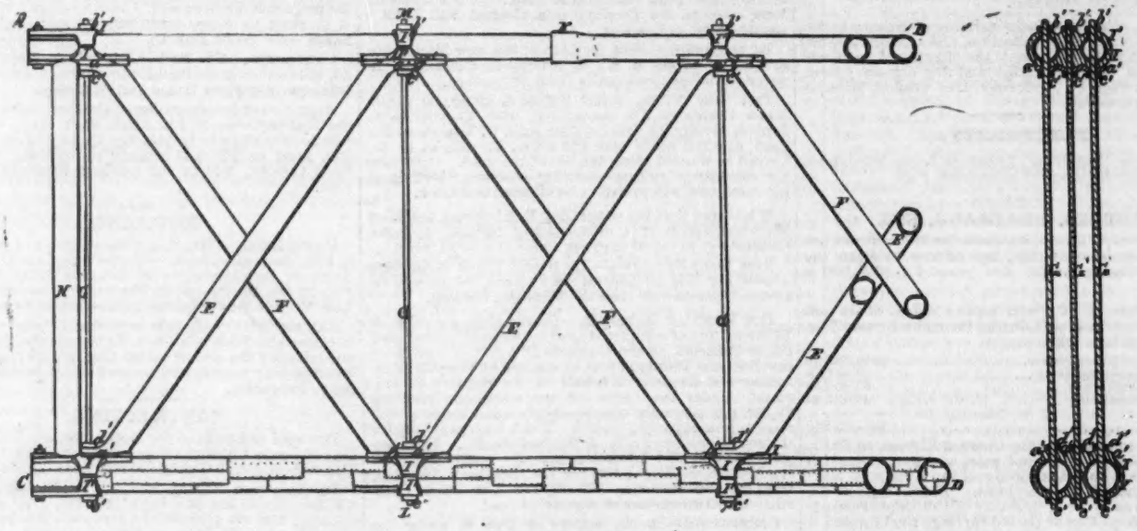
upper string, and passing diagonally through the stringers, bind and hold the posts in position. Combined with the diagonal thrust braces are short screw bolts, which pass diagonally through the stringers where they are united with the post at top and bottom to bind them together in the same manner, but in the reverse direction of the suspension rods.

a represents the upper, and *a'* the lower chords; *b*, the posts, etc., the diagonal thrust braces made double and having a screw bolt, *d*, between them at the upper and lower ends. A pin, *e*, secures the bolts by passing through the made in sections and connected by lapped joints, seen at *K*.

C D is the lower chord similarly constructed of tubular beams made of boiler iron riveted together *E* are the principal diagonal braces, and *F* the counter diagonal braces, all made of cylindrical tubes of wrought or cast-iron, and each cast with a toe piece, *a'*, at each end projecting from the opposite sides. *G* are the vertical suspension rods or bolts which pass down through the chords, toe pieces and counter-braces. The suspension rods are placed three abreast, with four nuts, *b' c' d' e'*, upon each, as seen in the sectional view. These rods connect the chords, and at the same time confine the braces and counter-braces in their

Copyright, 1882.

proper positions. At each end of the truss a cylindrical tubular post, *H*, may be inserted between the top and bottom chords, in order to aid in keeping them at their proper distance apart. *I* are metal saddles shaped to receive and support the chords. Counter saddles or stirrups, *I'*, are also employed. The ends of the braces and counter-braces rest in contact with the saddles *I* and are secured thereon by projections *f'* raised upon the saddles, the toes of the braces abutting against them.

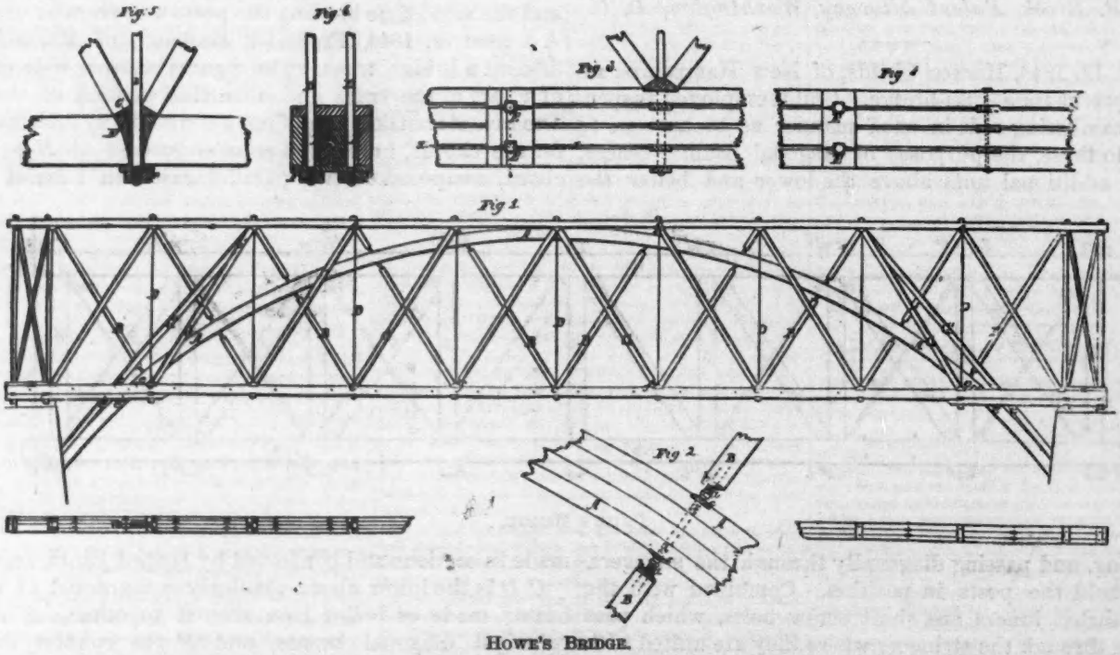


HARBACH'S BRIDGE.

The stirrups and saddles prevent the chords from being crushed or flattened by the action of the bolts and nuts. By confining the toe pieces of each diagonal brace and counter-brace directly to the saddles *I*, Harbach converts the brace into a suspension and counter-brace, as well as a thrust and counter-brace, thus resisting the vertical strains upwards as well as downwards. This guards, in a great measure, against the undulatory motion so destructive to railroad bridges, when a heavy train of cars run over it.

Aug. 28, 1846, William Howe, of Massachusetts, devised an improved truss bridge in which the arch beam is combined with the general truss in such manner that it may be made to co-operate with the other parts of the truss frame in raising or lowering the camber of the bridge. To accomplish this the inventor adopts a novel method of shortening and lengthening the braces.

Fig. 1 is a side elevation and Fig. 2 an enlarged view of the manner of connecting the arch beam with the counter-braces. Figs. 3, 4, 5 and 6 are detail views. The arch beam *A* passes independently between the principal braces *G*, which are double. The counter braces *B* abut on the blocks *c*, and are in the same plane with the arch, and when they would meet it they are cut off. The braces *B* have regulating screws *a a* tapped into a nut *C*. To render these metallic bearings independent of the shrinkage of the timber, there may be bolts *d*, shown by dotted lines extending from thence through the woodwork of the arch. *D* are the iron rods for straining up; they pass through the chords and have metal bearings in the sockets unaffected by the shrinkage of the chords. *E* represents said sockets extending entirely through the chords.



HOWE'S BRIDGE.

The arch is divided at the lower chord, as seen at *e e* so as to preserve the strength of the chord. Screws *f* are sometimes attached to the principal braces, the heads of which bear against the blocks *C*, which have a concavity in them for that purpose.

(TO BE CONTINUED.)